ONTARIO CLEAN WATER AGENCY
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Township of Ramara

Report for the Lagoon City Wastewater Servicing Strategy

SUBMITTED BY

Ontario Clean Water Agency
2085 Hurontario Street, Suite 500
Mississauga, ON L5A 4G1

Date: June 30, 2023
Project No: RAMARN1617-2242
Rev: 2

Issue and Revision Record					
Rev. No.	Date	Prepared by:	Reviewed by:	Approved by:	Rev. Description
1	December 19, 2022	Anna Duong, Jason Younker, Nick Larson	OCWA Operations	Nick Larson	Draft
2	June 30, 2023	Anna Duong, Jason Younker, Nick Larson	Township	Nick Larson	Final

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OCWA's Report to the Township of Ramara for the Lagoon City Wastewater Servicing Strategy

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1 Introduction

The Ontario Clean Water Agency (OCWA) has prepared this wastewater servicing strategy for the catchment of the Lagoon City wastewater treatment plant in the Township of Ramara, hereinafter referred to as the "Township".

The Lagoon City Wastewater Treatment Plant was constructed in the late 1970s. There was an expansion in 2008/09 to add an additional clarifier and sludge storage, but there has been no other significant rehabilitation or refurbishment on the facility. The facility services the settlements of Brechin and Lagoon City, and the serviceable lands in the Brechin/Lagoon City corridor.

The community of Brechin and the Brechin to Lagoon City corridor is expecting population growth over the next 20 years. The purpose of this wastewater servicing strategy is to provide the Township with a plan to manage the Lagoon City wastewater treatment plant over the long term to service current customers and accommodate planned development.

2 Work Plan

The work plan included the following activities:

- Preparation of a population growth estimate based on the development expected in the Lagoon City wastewater plant catchment area.
- Forecasting future wastewater flows based on the growth exercise and comparison against current capacity constraints of each process area of the treatment plant.
- Identification of facility expansion options to increase plant capacity to accommodate forecasted flows.
- Development of the scope, phasing and high-level cost estimates of the projects required to plan, design and construct the facility expansion.

3 Growth Planning

3.1 Growth Potential

The planning process at the Township starts with Simcoe County's population forecasts. The County allocates a percentage of growth to the Township, and the Township allocates their portion to their settlement areas. However, the current growth numbers are not reflective of the recent increase in development inquiries at the Township.

GSP Group completed an updated growth forecast in order to obtain a more accurate growth forecast. Appendix A contains the full report *GSP Group* report.

Table 1 summarizes the current versus build-out population and dwelling estimates.

Table 1. Population Forecast Summary

	2021 Estimated Serviced Dwellings	2021 Estimated Serviced Population	Build-Out Unit Growth	Build-Out Population Growth	Total Units @ Build-Out	Total Population @ Build-Out
Brechin	90	202	+1291 @ 20 Units/hectare +1710 @ 30 Units/hectare	+2776 @ 20 Units/hectare +3677 @ 30 Units/hectare	1381 @ 20 Units/hectare 1800 @ 30 Units/hectare	2978@ 20 Units/hectare 3879@ 30 Units/hectare
Lagoon City	934	1264	+337 @ 20 Units/hectare +442 @ 30 Units/hectare	+725 @ 20 Units/hectare +950 @ 30 Units/hectare	1271 @ 20 Units/hectare 1376 @ 30 Units/hectare	1989@ 20 Units/hectare 2214@ 30 Units/hectare
Total	1024	1486	+1628 @ 20 Units/hectare + 2152 @ 30 Units/hectare	+3501 @ 20 Units/hectare +4617 @ 30 Units/hectare	2652 @ 20 Units/hectare 3176 @ 30 Units/hectare	4966@ 20 Units/hectare 6093@ 30 Units/hectare

It is apparent from Table 1 that there is that there is the potential for the number of dwellings to almost triple if the new development is constructed at a density of 30 units per hectare. The key consideration for planning the facility upgrades is the speed at which this growth will occur.

3.2 Growth Timelines

The pace of new development is the key consideration for the technical aspects of the Lagoon City wastewater servicing strategy. The following points provide insight into this factor:

- Full build-out in Brechin and Lagoon City would take over 100 years if historic growth were indicative of future growth rates.
- However, the development environment has changed recently. The Township has approved 431 units for construction in Brechin over the next several years. Discussions are ongoing with several other development opportunities planned for the next 5 to 10 years, approaching almost 1,000 additional new units.

- If the development opportunities in the discussion are constructed, the Township will reach build-out within a 10 to 20 year timeframe.

4 Flow Analysis

4.1 Current Wastewater Flows

The Lagoon City and Brechin catchment area have its wastewater treated at the Lagoon City Waste Water Treatment Plant (WWTP). This treatment plant has a theoretical wastewater treatment capacity of 2,273 m^3/day. Existing average flows are approximately 1,276 m^3/day or 56% of the total treatment capacity. Figure 1 below presents the above information along with the plant's flow history.

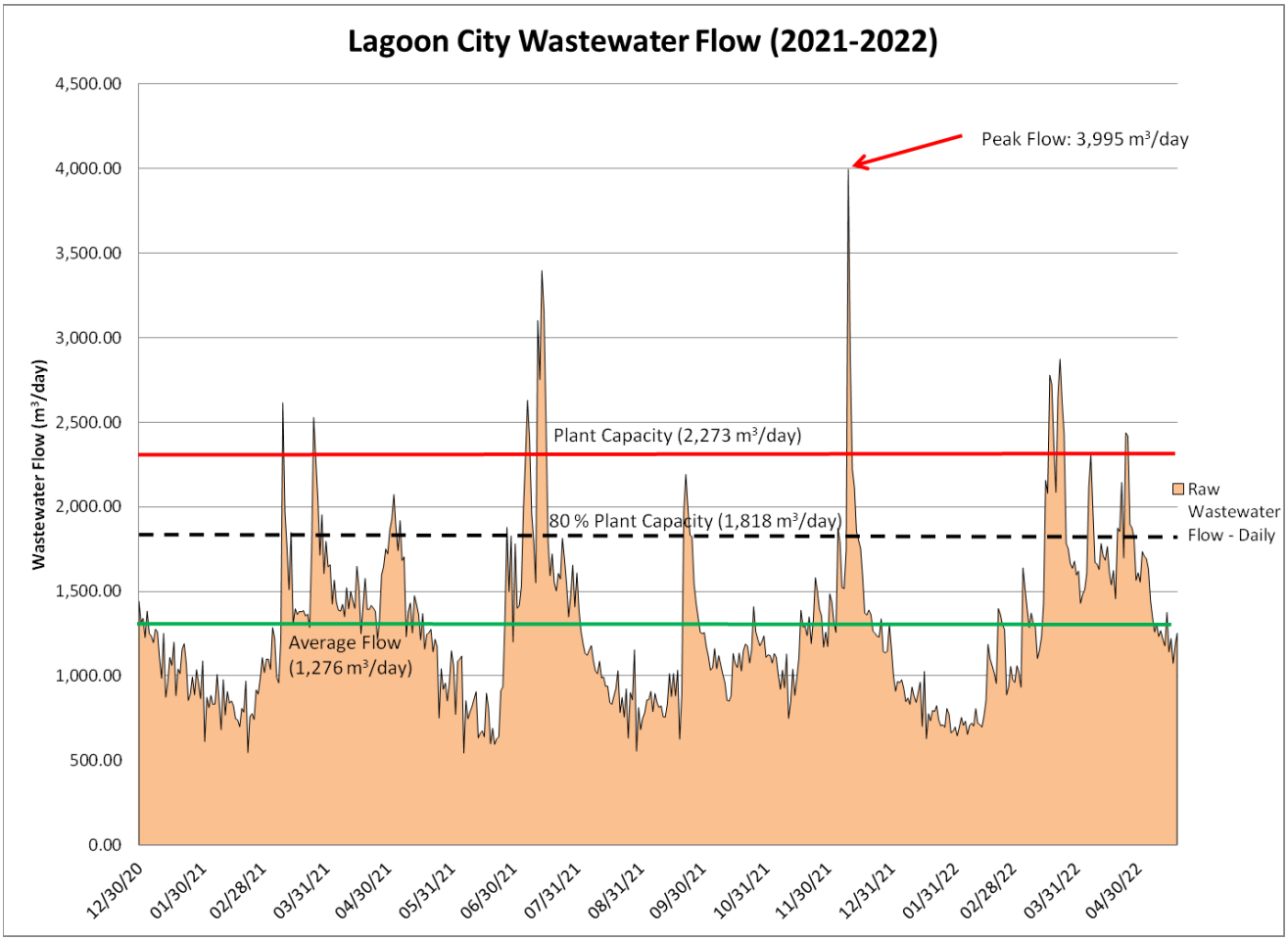

Figure 1: Lagoon City Raw Wastewater Flow History (2021-2022)

It is apparent from Figure 1 that raw wastewater flows can vary greatly due to the ingress of extraneous water into the collection system (i.e. inflow/infiltration of groundwater/surface

water). This results in raw wastewater flow regularly exceeding the Plant's treatment capacity for short durations.

Other considerations of the current wastewater flows are as follows:

- Planning for plant expansion should begin when average flows reach 80% of their treatment capacity, and construction should begin when average flows reach 90% of treatment capacity.
- It may be feasible to eliminate some of the extraneous water from the collection system through a program to rehabilitate sewer laterals (both public and private sides), mainline sewer segments, or maintenance holes. However, it is difficult to estimate the real flow reduction from the rehabilitation program until sufficient flow data analysis occurs.
- OCWA is in the process of preparing an Inflow and Infiltration reduction plan for the Bayshore collection system. This plan will identify a series of rehabilitation activities to complete on the collection system to reduce extraneous flow ingress. The rehabilitation work is expected to begin in 2023.
- The Township is planning to complete a similar work package on the Lagoon City collection system (i.e. CCTV inspections to identify deficiencies followed by rehabilitation activities to fix deficiencies). The Bayshore rehabilitation program will provide valuable insight into the real flow reduction that may be feasible to achieve with the rehabilitation of the entire Lagoon City collection system.

4.2 Flow Projection

Figure 2 summarizes the flow projection at the Lagoon City wastewater treatment plant. Due to the uncertainty with the development timing, the flow projection is based on new housing units constructed (rather than time). The following observations are noted:

- 80% plant capacity will be realized with approximately 400 new units. 100% plant capacity will be realized with approximately 650 new units.
- Reducing extraneous flows would enable servicing of more units, if observations following the rehabilitation program demonstrate a measurable decrease in plant flows. For conceptual planning purposes, a *30% Extraneous Flow Reduction* line in included on Figure 2. This would defer the 80% plant capacity until approximately 650 units. However, as discussed in Section 3, the number of planned units in active discussion already exceeds this number.
- The reduction in extraneous flows observed following the Bayshore collection system rehabilitation program (and ultimately Lagoon City system) would be used to calibrate future flow forecasts.

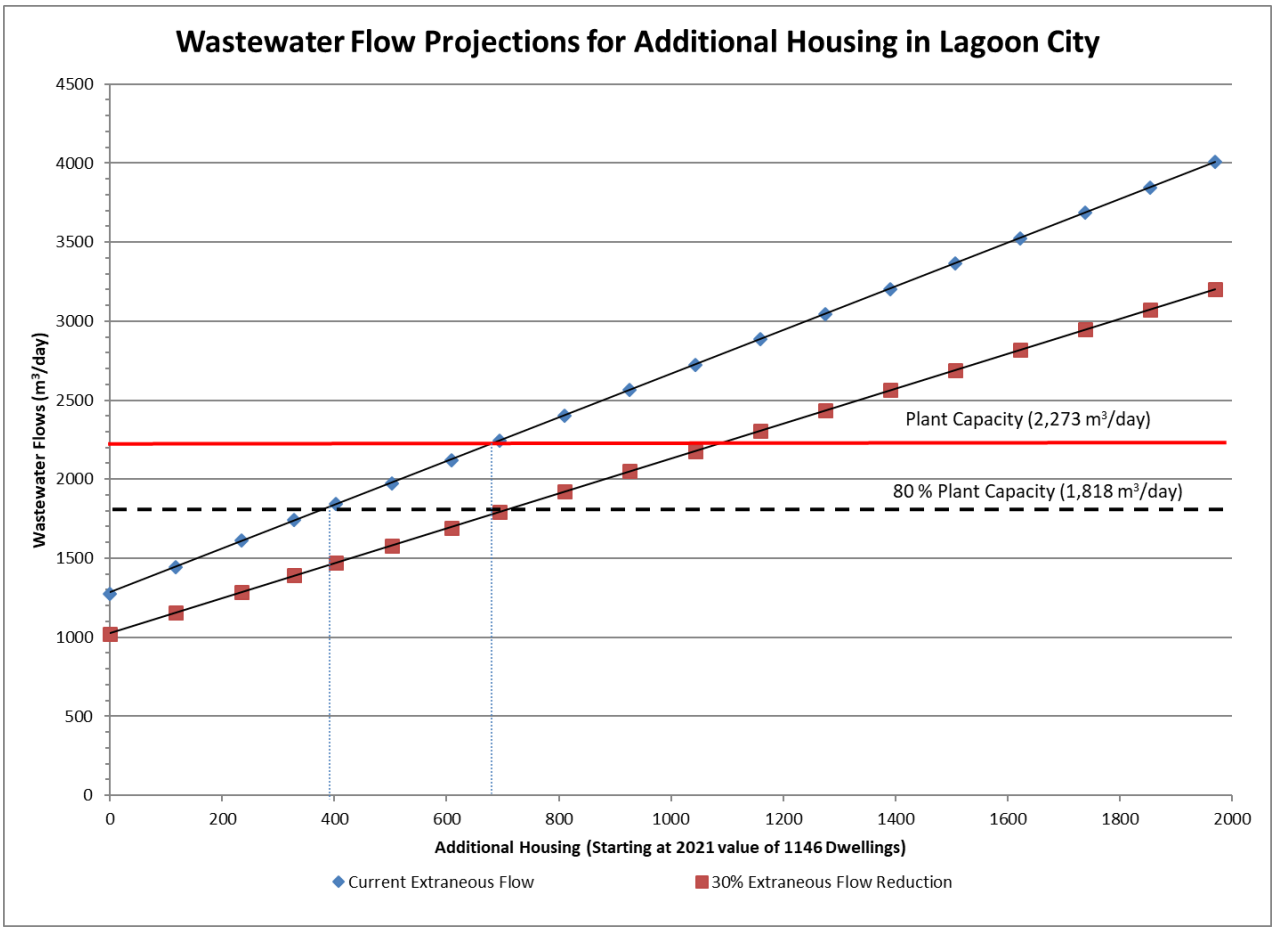

Figure 2: Wastewater Flow Projections as Additional Dwellings are Added

5 Existing Plant Process Capacities

The Lagoon City WWTP's has a theoretical rated capacity of 2,273 m^3/day. Three key processes are discussed in this Section that would need to be addressed if Lagoon City wastewater plant is to continue operations over the long term.

- *Pre-treatment works (bar screen and degritting channels)* – this process provides substandard performance and is an obsolete design. The bar screen itself has no automatic mechanism for material removal, the spacing of the bar screen is at least 12mm allowing significant solid materials to pass through the screen, and the screen itself has to be jury-rigged with chicken wire to maintain minimum performance. Likewise, the degritting channel has no way to automatically remove settled materials. This level of poor pre-treatment effectiveness can affect the entire plant's performance with materials that should be removed in pre-treatment being passed onto the later

treatment process that is not designed to handle them. The Lagoon City screen and de-gritting works requires upgrading to modern design standards.

- *Aeration cells* – the three aeration cells are circular in-ground ponds with a central mechanical aerator for both aeration and mixing. This type of design is long out of use - centralized aeration does not provide uniform aeration, centralized mixing leads to the settling of material around the edges and bottom of the cell, the design has electrically inefficient mechanical aerators, and there is potential groundwater contamination if there is no liner at the base of the cells. Given the design issues, it is unlikely that the practical performance of the aeration cells could achieve their theoretical treatment capacity. More modern aeration systems would require less electrical usage, require a smaller footprint, and provide more effective treatment.

- *Sludge storage* – the sludge storage capacity is below the nominal design for the plant. This indicates that the plant will either need to expand its sludge storage capacity before any major expansion occurs.

Table 2 summarizes the plant's main operational issues of the processes mentioned in this section with the according recommendations.

Table 2: Current Performance and Operational Issues

Process	Performance Issues/Operational Challenges	Recommendation
Bar screen and Degritting	Excessive grit and material pass through causing issues downstream	Upgrade recommended for continued use
Aeration Cells	Archaic design, inefficient electrical use, limited effective treatment	Upgrade recommended for continued use
Digesters and Sludge Storage	Undersized if Plant needs expansion	Expansion is recommended

6 Plant Capacity Expansion Options

As shown in Section 4, as the plant reaches 80% of rated capacity after an increase in the serviced population of 620 (or 387 dwellings have been constructed), an expansion will be required to accommodate any future growth beyond those initial houses. This expansion can take one of two forms:

1. Expansion of the existing facility; or

2. Construction of a new treatment plant (with the old facility converted into a pumping station that conveys flows to the new facility).

6.1 Current Facility Overview

Figure 4 depicts the current site layout of the Lagoon City Wastewater Treatment Plant. The plant includes the headworks, three aeration cells, a sludge storage tank, the sludge digester, a septage receiving station, and three rectangular final effluent clarifiers.

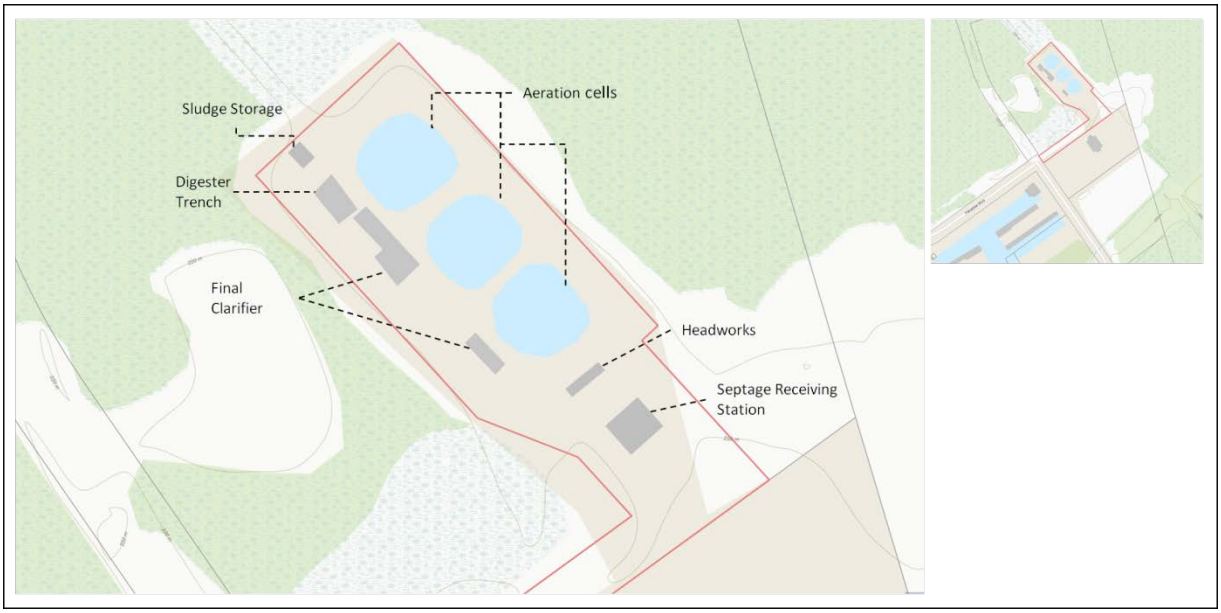

Figure 3: The Current Lagoon City Wastewater Treatment Plant Site Overview

6.2 Facility Expansion Upgrade

Several major process upgrades are necessary to maintain operations into the future:

- Full renewal of headworks and aeration cells to modern standards;
- Sludge storage and digester capacity expansion;
- Installation of a new tertiary treatment system (likely disc or cloth filters) as it will likely be required to meet environmental regulatory approvals to discharge into Lake Simcoe.

Figure 4 and Table 3 summarize the upgrade recommendations assuming a capacity upgrade to 3,000m^3/day.

Table 3: Upgrade recommendations and associated estimated costs

Upgrades	Description	Cost Range
Replacement of Headworks	Construction of new Headworks building with both screening and degritting treatment processes	$4-6M
Aeration Cell Retrofit	Using a more footprint compact technology, replace primary aeration cells (ex. MBBR).	$4-6M
Expansion of Sludge Storage	x2-x3 capacity expansion of Sludge Storage	$3-5M
Expansion of Digesters	Double Capacity of Existing Digesters	$2-4M
Tertiary Upgrade	Construction of tertiary treatment system (Disc Filters, Cloth Filters, etc.). Will require the footprint of one of the existing aeration cells.	$9-12M
Re-piping Work	Piping between the treatment processes may need major rework.	$1-2M
Electrical Works	Additional electrical may be required to handle new equipment	$1-2M
Design	Cost for a design consultant to prepare the drawings and specifications.	$2-4M
Project Management	Project Management fees to manage design and construction	$1M
TOTAL		**$27-41M**

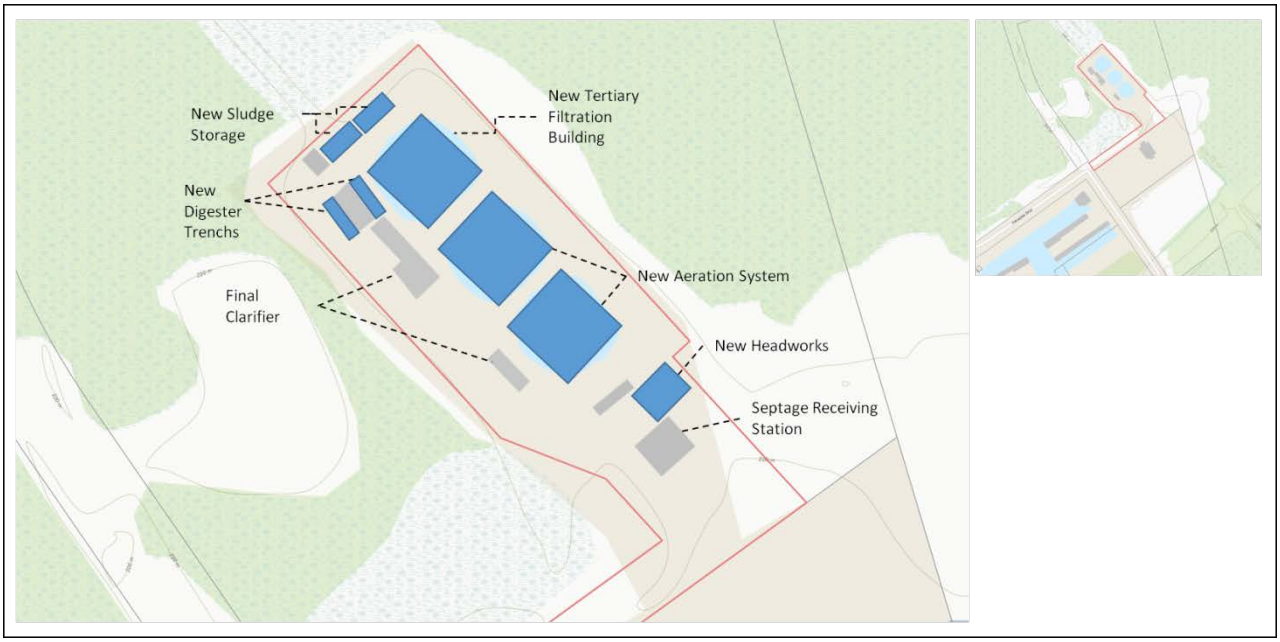

Figure 4: Site Overview with upgrades to expand plant capacity identified

Advantages:

- Does not require a new forcemain to a new plant site.
- Could upgrade plant in stages as demand increases.
- Could immediately start some upgrades.

Disadvantages:

- Difficult to construct on small site footprint. May require additional land acquisition adjacent to current facility. Low-footprint treatment technologies will be more expensive.
- Current site surrounded by protected wetlands. Approvals for any sewage works would be challenging.
- Major construction work at an in-service plant is technically difficult, and can result in longer schedules and higher costs.
- Areas of the plant that are not upgraded will likely require equipment replacement rehabilitation efforts to be maintained to account for deterioration from daily operations; these costs are not accounted for in the budget above.

6.3 New Facility Construction Option

This section provides a discussion on the strategy of building a new wastewater treatment plant to replace the existing facility. The estimated design capacity of the new treatment plant is approximately 3,000 m^3/day to meet forecasted 50-year flows.

The adjacent land that is next to the current Lagoon City plant may be a suitable site for the new plant construction option. Section 2.1 of the Provincial Policy Statement protects most of the land area in Lagoon City from development and site alteration. However, there is some land adjacent to the current plant that is an unevaluated wetland. It may be feasible to construct a new facility in this area. Discussions with the approval agencies should begin immediately to investigate the feasibility of constructing a new facility in this area.

Table 4: New facility construction cost estimates

Upgrades	Description	Cost Range
New facility	Construction of the entire treatment system facility including all the treatment processes (headworks, aeration cell, sludge storage, sludge digesters, tertiary system, piping, electrical work, etc.)	$25-50M
Force mains	Construction of the required force mains and new pumping stations.	$4-7M
Design	Cost for a design consultant to prepare the drawings and specifications.	$3-5M
Project Management	Project Management fees to manage design and construction.	$1M
TOTAL		**$32-61M**

If the location adjacent to the current facility is not feasible, the closest likely locations for a new WWTP in the area are either 2-3km east of the existing plant or 2-3km south. Both sites would be on major roads with feasible locations. Note that a new forcemain would be required to convey flows from the current facility to the new facility.

Advantages:

- A new optimal site with sufficient room to expand the facility to accommodate future long-term growth.
- It is less complex to maintain operations at the current facility while constructing the new facility, and then transfer flows to the new facility when ready.
- A new facility treats current flows with planned modular expansions of certain process areas to treat future flows as they increase.

Disadvantages:

- A new facility is likely to cost more than the cost to expand the current facility.
- The addition of a new force main and conversion of the existing plant to a pumping station would also be required.
- The timeline of site selection, approvals, financing, design and construction is 5 to 10 years.

6.4 The Practicality of Reducing Inflow and Infiltration

The inflow and infiltration levels in the Lagoon City WWTP catchment area are substantial. At this point, the magnitude of flow reduction resulting from a future rehabilitation program is uncertain. The Township should continue with planned CCTV inspections and rehabilitation activities to reduce inflow and infiltration, and monitor post-rehabilitation flows.

If the Inflow and Infiltration reduction program is successful (i.e. there is a consistent, measurable reduction in wastewater flows observed), then it is appropriate to reduce the design capacity of the WWTP process areas. This would result in cost savings and allow for a comparison of the cost to eliminating the extraneous flows via the full system rehabilitation program against the savings from building a smaller facility.

7 Recommendations

OCWA recommends the following:

- The Township recognizes that the development of more than 387 homes will trigger the recommendation to start the initial works towards upgrading the WWTP, starting with a Municipal Class Environmental Assessment (MCEA),
- The Township immediately engages in procurement for an MCEA (Class C) for the determination of the most appropriate WWTP capacity upgrade option/design since over 400 units are approved for construction.
- The Township should begin the financial planning processes to fund a large project at the Lagoon City facility based on the cost estimates in this report. More specific financial strategies can be developed as the project progresses.
- The Township should continue with the inflow and infiltration program to reduce extraneous flows in the Lagoon City collection system.

APPENDIX A
Development Forecast (GSP Group)

SHAPING GREAT COMMUNITIES

Memorandum

To:	Nick Larson, P.Eng. Senior Project Manager, OCWA	**Date:**	May 12, 2023
From:	Patrick Casey Planner, GSP Group Inc.	**File No.:**	22151
Re:	**Development Forecast for Lagoon City & Brechin Township of Ramara, Simcoe County**		

Executive Summary

This memorandum presents 2021 population and employment estimates for the settlement areas of Lagoon City and Brechin in the Township of Ramara, as well as projections for full residential build-out of these settlement areas.

- Baseline estimates for 2021 give a combined population of 1,593 people living in the two settlement areas (1,381 in Lagoon City and 212 in Brechin). We further estimate a total of 1,486 permanent residents living in the "serviced area" adjacent to existing sanitary mains (1,264 people in Lagoon City and 202 people in Brechin, as well as 20 people in the serviced "OPA 17" area between the two settlement areas).
- In terms of employment, baseline estimates for 2021 give a total of 1,219 jobs in the two settlement areas: 533 population-related employment (PRE) jobs in Lagoon City, 587 PRE jobs in Brechin, and 99 employment-land employment (ELE) jobs in Brechin.
- Based on Census data from 2006 to 2021, we estimate that, moving forward, around 60% of the Township's overall population growth will be directed to the four Villages (Atherley-Uptergrove, Brechin, Lagoon City, and Longford Mills), of which 40%, or 24% of the Township's overall growth, will be directed to either Lagoon City or Brechin.
- The number of existing vacant and "underutilized" residential lots, combined with the number of dwelling units in the approved plan of subdivision in Brechin, gives the potential for another 272 dwelling units in Lagoon City (128 on lots in the "serviced" area) and 454 potential units in Brechin.

- On remaining vacant residential parcels, the likeliest scenarios for future development give the potential for somewhere between 1,147 additional units (at 20 units per gross hectare) and 1,721 additional units (at 30 units per gross hectare).
- Under the likeliest scenarios, the total unit potential is for:
    - at 20 units per hectare, 582 additional units in Lagoon City (337 in the serviced area) and 1,291 units in Brechin, for a total of 1,873 potential units; and,
    - at 30 units per hectare, 737 additional units in Lagoon City (442 in the serviced area) and 1,710 units in Brechin, for a total of 2,447 potential units.
- By 2051, the likeliest scenarios give a combined population of 2,119 people living in either Lagoon City or Brechin (1,491 people in Lagoon City and 628 people in Brechin in the 20-unit-per-hectare scenario, and 1,487 people in Lagoon City and 632 people in Brechin in the 30-unit-per-hectare scenario).
- Based on projected growth rates, full build-out of the two settlement areas under the two likeliest scenarios is projected to occur in the second half of the 22nd century: either in 2155 for the 20-unit-per-hectare scenario or in 2182 for the 30-unit-per-hectare.

This memorandum is divided into two parts: the first part presents 2021 population and employment estimates for the settlement areas of Lagoon City and Brechin in the Township of Ramara (referred to as “baseline” estimates), while the second estimates the potential population growth that can be expected once all developable residential lands in these settlement areas has been built out.

The principal data sources are Statistics Canada’s Census of Population and Simcoe County’s online GIS mapping, as well as documents prepared in support of the County’s municipal comprehensive review. The body of this memo explains the various assumptions that have been used in arriving at the final estimates and projections.

Population Estimates

Population estimates for the settlement areas of Lagoon City and Brechin were based on Dissemination Block data from the 2021 Census of Population conducted by Statistics Canada. Dissemination Blocks (“DBs”) are the smallest geographical areas for which Census data for population and dwelling counts are available; the boundaries of DBs are based primarily on the road network, meaning that, in built-up areas, a DB is roughly equivalent to a city block.

However, the boundaries of Census Dissemination Blocks do not exactly correspond to the boundaries of the settlement areas of Lagoon City and Brechin. The 2021 Census has a total of 20 DBs that overlap part of at least one of the two settlement areas: 12 DBs that overlap parts of Lagoon City, seven DBs that overlap parts of Brechin, and one DB that overlaps parts of both, as well as the lands between the two settlement areas along the north side of Simcoe Road / Ramara Road 47 that are the subject of OPA 17. **Figure 1** shows the boundaries of the Census Dissemination Blocks that overlap Lagoon City and Brechin.

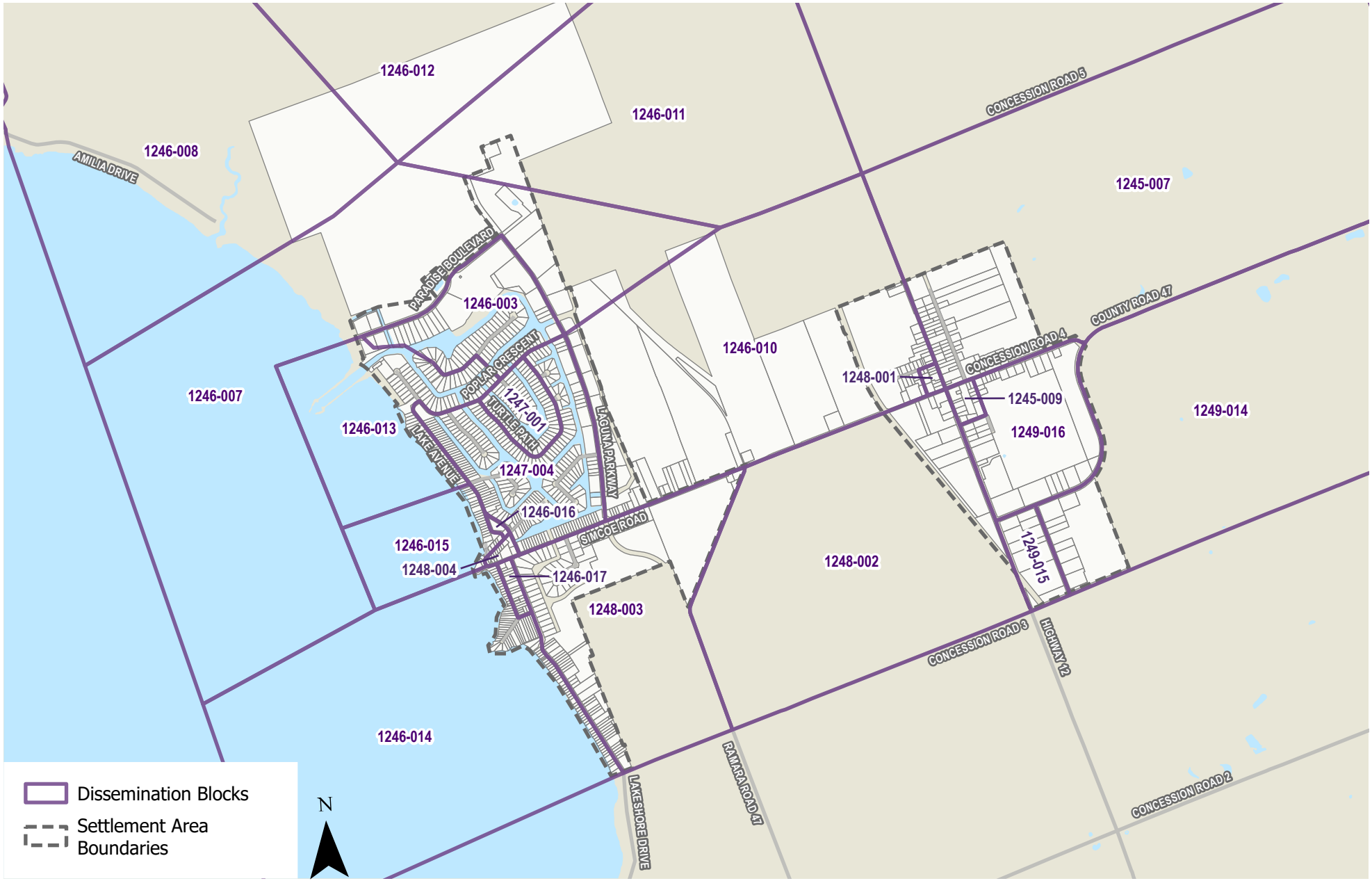

FIGURE 1
CENSUS DISSEMINATION BLOCKS
LAGOON CITY & BRECHIN

1: 30,000

0 250 500 1,000

Meters

DRAWN BY: MN

SOURCE: Township of Ramara (2022)
Stats Canada (2022)
GSP Group (2022)

GSP group

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Of the 13 DBs that overlap parts of Lagoon City (i.e., the 12 DBs that overlap only Lagoon City and the additional DB that overlaps both settlement areas), 9 are fully located within the Lagoon City settlement area boundaries of the Lagoon City, while the remaining 4 have portions that are not within the settlement area. Similarly, 4 out of the 8 DBs that overlap parts of Brechin are fully located within that settlement area, while the other 4 have portions located outside the settlement area boundaries. From this point on, DBs that are located fully within one of the two settlement areas will be referred to as "Full DBs", whereas those located only partially within a settlement area will be referred to as "Partial DBs".

The population and dwelling counts for Full DBs are given directly by the Census DB data, which give the total number of dwellings as well as the number of dwellings occupied by "usual residents" (i.e., people whose primary residence is in the DB in question; the shorter term "occupied dwellings" will be used from this point on to refer to "dwellings occupied by usual residents"). For Partial DBs, the number of dwellings within each settlement area was estimated based on aerial photographs from the Township's and Simcoe County's online mapping sites. (The most recent photographs available on these sites are from 2018.) Population estimates were then derived using the overall "occupancy rate" (the number of occupied dwellings divided by the number of total dwellings) and average household size (population divided by the number of occupied dwellings) for each DB. While this method assumes that these averages hold across the entire DB, it nonetheless provides us with a reasonably accurate estimate of the population.

It will be helpful to consider an example to illustrate the process. Dissemination Block No. 35431246010, referred to from this point on as DB No. 1246-010,[1] is a Partial DB that overlaps the easterly edge of the Lagoon City settlement area (as well as the northwesterly quadrant of Brechin and most of the lands in between that are subject to OPA 17). The area covered by DB No. 1246-010 includes most of the condominium developments that have frontage on Laguna Parkway, as well as the properties on the north side of Simcoe Road to the east of the intersection with Laguna Parkway. According to the 2021 Census, DB No. 1246-010 had a population of 402 people and a total of 245 dwellings, of which 205 were occupied by usual residents, which translate to an occupancy rate of 83.7% and an average household size of 1.96 people per occupied dwelling.

Aerial photographs and data on condominium parcels (also available through Simcoe County's online GIS mapping site) indicate that approximately 216 of the DB's total dwellings, or about 88%, are located within the Lagoon City settlement area. We therefore estimate that 88% of the DB's population lives in the settlement area, or an estimated 354 people. Similarly, we estimate that 88% of the occupied dwellings in the DB, or 181 occupied dwellings, are found within Lagoon City.

A similar method was used to estimate the populations of the two settlement areas using data from both the 2006 and the 2016 Censuses. The estimated population and dwelling counts from these

[1] Each Dissemination Block is assigned a unique 11-digit identifier. The first two digits indicate the province in which the DB is located (in this case, "35" for Ontario), while the second pair of digits identify the Census Division: "43" is the two-digit code used for the geographic area of Simcoe County. The remaining digits identify the Dissemination Area ("1246") and the Dissemination Block ("010").

Table 1 – Population and dwelling counts, 2006–2021

Census Year	Lagoon City			Brechin		
	Population	Total dwellings	Occupied dwellings	Population	Total dwellings	Occupied dwellings
2006	1,141	1,024	569	202	92	76
2016	1,194	1,039	621	200	95	84
2021	1,342	1,051	692	206	95	87

three Census years are presented in **Table 1**. Full tables containing the data for each individual DB can be found in **Appendix "A"**.

It is generally necessary to adjust the results of the Census to account both for under-coverage (i.e., people who were omitted from the Census) and for over-coverage (i.e., people who were included more than once).[2] Statistics Canada estimates these rates based on post-censal studies, which have not yet been completed for the 2021 Census of Population. According to the Coverage Technical Report prepared after the 2016 Census, the net under-coverage rate for Ontario in both 2011 and 2016 was around 2.8% (down from an estimated 3.7% in 2006). Although the net under-coverage rate from the 2021 Census is not yet known, the most recent forecasts from Simcoe County's MCR give a population of 10,680 people for 2021. Compared to the population of 10,377 people reported in the 2021 Census Profile for Ramara, this translates to a net under-coverage rate of 2.9%, well in line with those of previous censuses.

Table 2 shows the population estimates for Lagoon City and Brechin (both separately and combined) from 2006 through 2021, after the DB data have been adjusted to account for net under-coverage in their respective Census years. As shown in that table, we estimate that, in 2021, there were 1,381 people living in Lagoon City and another 212 people living in Brechin, giving a combined total population of 1,593 people for the two settlement areas. This corresponds to an average annual growth rate of 0.89% from 2006 to 2021 (average annual growth of 1.03% in Lagoon City and 0.05% in Brechin). However, the five-year average annual growth rate (2016–2021) for the two settlement areas is significantly higher, at 2.1% (2.4% in Lagoon City and 0.6% in Brechin).

According to these estimates, the average household size in each settlement area has decreased since 2006, from 2.08 people per dwelling ("ppl/dw") to 2.00 ppl/dw in Lagoon City and from 2.16 ppl/dw to 2.04 ppl/dw in Brechin. The occupancy rate in Lagoon City has consistently been much

[2] For a detailed explanation, see the "Differences between Statistics Canada's census counts and population estimates" page on Statistics Canada's website (https://www.statcan.gc.ca/en/hp/estima). Historical estimates of under-coverage and over-coverage rates can be found in the *Coverage Technical Report, Census of Population, 2016* (see https://www12.statcan.gc.ca/census-recensement/2016/ref/98-303/chap11-eng.cfm).

Table 2 – Population estimates and dwelling counts, 2006–2021

Census Year	Population			Total dwellings (Lagoon City & Brechin)	Occupied dwellings (Lagoon City & Brechin)
	Lagoon City	Brechin	Total		
2006	1,183	210	1,393	1,116	645
2016	1,227	206	1,433	1,134	706
2021	1,381	212	1,593	1,146	779

lower than that in Brechin — a rate of 65.8% in Lagoon City in 2021 means that just over one third of all dwellings in the settlement area were either unoccupied or occupied by seasonal residents (as compared to a 2021 occupancy rate of 91.9% in Brechin).

Serviced Area Population

For the purposes of this memorandum, the term “serviced area” is used to refer to the area occupied by all parcels, including those in the “OPA 17” area outside the current settlement area boundaries, that are adjacent to an existing sanitary sewer main. Figure 2 shows the extent of the serviced area, which identifies those parcels that could potentially be serviced by existing sanitary mains, which may or may not have municipal sanitary services at present. As shown in **Figure 2**, the serviced area does not include most of the parcels within the Lagoon City settlement area to the south of Simcoe Road, but does include most of those in the “OPA 17” area, as these are adjacent to the existing main along Simcoe Road / Ramara Road 47.

Adjusting the DB data based on the serviced area gives **an estimated 2021 serviced area population of 1,486 people** (adjusted for net under-coverage), with about 1,264 people in Lagoon City, 202 people in Brechin, and 20 people in the “OPA 17” area between the two settlements. It should be emphasized that this figure represents the number of people who could potentially be serviced by existing sanitary mains, not the current number of people with municipal sanitary sewer services.

Population Estimates for Other Settlement Areas

The Official Plan currently in effect for the Township of Ramara identifies four “Villages” (or “Full Service Settlement Areas”): Lagoon City, Brechin, Atherley-Uptergrove, and Longford Mills. Using the same method as was used for Lagoon City and Brechin, it has been estimated from Census Dissemination Block data that the population of Atherley-Uptergrove has grown from 1,172 people in 2006 to 1,485 people in 2021 (both adjusted for net under-coverage), while the population of Longford Mills has remained essentially unchanged at between 40 and 50 people. (There is much less confidence in the estimates for Longford Mills, which covers a relatively small geographic area

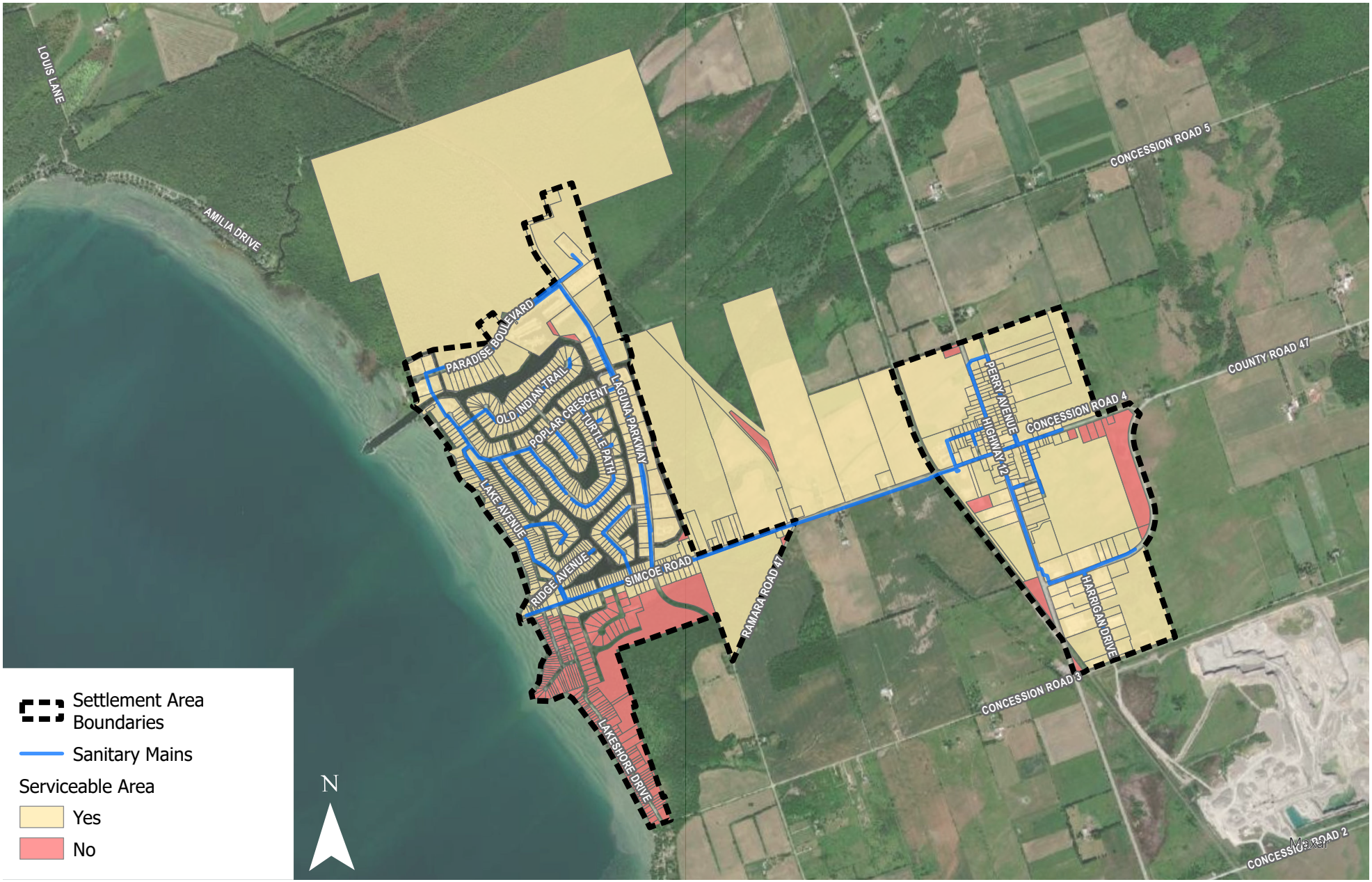

FIGURE 2
SERVICEABLE AREAS
LAGOON CITY & BRECHIN

ONTARIO CLEAN WATER AGENCY - GROWTH ESTIMATE STUDY | MAY 2023

1: 30,000

0 250 500 1,000

Meters

DRAWN BY: MN

SOURCE:
Township of Ramara (2022)
GSP Group (2022)

GSP group

that includes portions of two much larger Census DBs, most of which are located outside the settlement area boundaries.)[3]

Taken together, the four Villages had a combined population of about 3,120 people in 2021, roughly 30% of the Township's total. This is an increase of about 600 people from their combined 2006 population of 2,610 people, which was approximately 27% of the Township's total of 9,775 people.

Employment Estimates

Simcoe County's most recent employment forecasts for Ramara Township, prepared by Hemson Consulting Ltd. ("Hemson") as part of the County's ongoing municipal comprehensive review ("MCR"), were released in March 2022. According to these forecasts, there were 5,380 jobs in Ramara Township in 2021: 3,130 population-related employment jobs, 330 employment-land employment jobs, and 1,920 rural employment jobs. (By definition, rural employment jobs are located outside of settlement areas, and therefore this category of employment will generally be omitted from the discussion from this point on.)

The report prepared by Hemson to accompany the MCR population and employment forecasts explains that "population-related employment" ("PRE") refers to "employment that primarily serves local residents, both permanent and seasonal, including retail, education, health care, food service, accommodation, and local government, and people who work from home full-time." For the most part, population-related employment jobs tend not to be located on employment lands. "Employment-land employment" ("ELE"), on the other hand, "refers to employment accommodated primarily in low-rise industrial-type buildings, the vast majority of which are located within business parks and industrial areas."

Population-Related Employment

As the Hemson MCR report from March 2022 points out, while growth in population-related employment ("PRE") jobs tends to follow population growth, both in terms of number and in terms of location, new PRE jobs are directed to locate in "Community Areas", which essentially means the same thing as "settlement areas." According to Section 4.1.2 of the Township of Ramara's Official Plan, there are nine settlement areas in the Township: four "Villages" (Atherley-Uptergrove, Brechin, Lagoon City, and Longford Mills), which are fully serviced, and five "Hamlets" (Cooper's Falls, Gamebridge, Sebright, Udney, and Washago), which are referred to as "Limited Service Settlement Areas."

The estimated number of PRE jobs presented here is based on the assumption that existing PRE jobs are distributed across all nine settlement areas. However, because most growth and development are directed to the four fully serviced Villages, we will assume that most future PRE growth will take place in those four settlement areas (the exception being work-from-home PRE jobs, which we will assume will be distributed according to the overall distribution of population).

[3] The population estimates for Atherley-Uptergrove and Longford Mills were undertaken for the purpose of informing both the estimated distribution of population-related employment jobs in the next section of this memo and the estimated distribution of population growth forecast beyond 2021.

Residential PRE Jobs

According to the most recent MCR forecasts, there were 3,130 PRE jobs in Ramara Township in 2021, which according to the definition of PRE includes "people who work from home full-time." The 2017 Employment Land Budget for Ramara Township, also prepared by Hemson for Simcoe County, estimates a work-at-home rate of 8% of the population in 2011 (745 jobs for a population of 9,543 people), and forecasts this rate to decrease to 6% by 2031. However, the work-from-home rate in the Employment Land Budget is based on the results of the 2011 National Household Survey ("NHS"), which was a significant outlier when compared to both the 2006 and 2016 Census Profiles for the Township. According to the 2016 Census Profile, there were 405 people working from home, which is about 4.2% of the population of 9,750 people (adjusted for net under-coverage). Similarly, the 2006 Census Profile gives 415 people working from home out of a population of 9,775 (again adjusted for net under-coverage), also a rate of about 4.2%. Moreover, all of these rates reflect the number of people working from home before the COVID-19 pandemic. (Place-of-work data from the 2021 Census are scheduled for release on November 30, 2022, and are thus not yet available.)

Let us therefore assume a post-pandemic work-from-home rate in the Township of 6% of the total population, which is the rate that the 2017 Employment Land Budget forecasts by 2031. (It is worth emphasizing that this is the percentage of people working from home full-time, and not those working from home part-time who also have a regular place of work outside the home.) This 6% rate strikes a reasonable compromise between the data from the 2006 and 2016 Censuses and the estimates in the 2017 Employment Land Budget, while also accounting for a small increase in the number of people working from home post-pandemic.

Applying this estimated work-from-home rate to the Township's total 2021 population gives an estimated total of 641 people working from home full-time across the Township, with an estimated 83 of those people living in Lagoon City and another 13 people living in Brechin. (These work-from-home jobs will be referred to as "Residential PRE" jobs — i.e., PRE jobs located on residential lands — from this point on.)

Non-residential PRE Jobs

Subtracting the 641 Residential PRE jobs from the Township's 2021 total of 3,130 PRE jobs gives a remaining 2,489 PRE jobs to be accounted for, which as mentioned above we assume are distributed across the nine settlement areas.

Our estimate of how the remaining PRE jobs are distributed among commercial, institutional, and industrial employment is based on "Labour by industry" data from the 2016 Census. These data identify the number of people working in various industries, organized according to the North American Industry Classification System ("NAICS") 2012 (see **Appendix "B"**).[4] Two of these

[4] The 2016 Census Profile also provides data on the number of people working in different occupations, classified according to the National Occupational Classification (NOC) 2016. The estimates presented here are based on industry, rather than occupation, because the former is a more accurate indicator of where such jobs are likely located. For instance, one of the NOC categories is "Management occupations," which could take place on commercial, institutional, or employment lands.

categories — “Agriculture, forestry, fishing and hunting” and “Mining, quarrying, and oil and gas extraction” — have been treated as “rural employment” types and are thus generally omitted from the discussion that follows. (The “Management of companies and enterprises” category, which according to the 2016 Census Profile did not employ anyone in the Township of Ramara, has also been omitted.)

Of the remaining 17 categories, three are considered “employment land employment” (“Manufacturing”, “Transportation and warehousing”, and “Administrative and support, waste management and remediation services”), while another two (“Construction” and “Wholesale trade”) have been considered “Industrial PRE”: “Construction” because it is at least somewhat related to population growth, and “Wholesale trade” because it is related to the “Commercial PRE” category “Retail trade”. This leaves seven industry categories that we will assume are primarily located on commercial lands and another five located on institutional lands.[5]

According to the land use and employment type classification described in the previous paragraph, in 2016 there were a total of 3,630 PRE jobs in Ramara,[6] of which 1,590 (43.8%) were “Commercial PRE” jobs, 1,450 (39.9%) were “Institutional PRE” jobs, and 590 (16.3%) were “Industrial PRE” jobs. (The term “Industrial” is used here to avoid confusion with the term “Employment Land Employment”.) For our present purposes, we will simplify these percentages and assume that, of the remaining 2,489 non-residential PRE jobs in Ramara, 45% are Commercial PRE jobs, 40% are Institutional PRE jobs, and 15% are Industrial PRE. These percentages give us an estimated 1,120 Commercial PRE jobs, 996 Institutional PRE jobs, and 373 Industrial PRE jobs across Ramara Township in 2021.

Parcel data provided by the Township, combined with a survey based on aerial photographs available through Simcoe County’s online GIS, were used to estimate the distribution of non-residential PRE jobs across Ramara Township based on the distribution of occupied commercial, institutional, and employment lands, assuming that a uniform average employment density applies across the entire Township. The total occupied areas, which are shown in **Table 3**, include the full area of all occupied parcels and the non-vacant portions of parcels that were identified as “underutilized.” (The commercial and institutional lands identified as being in the Rural Area consist of three parcels at the intersection of County Road 169 and Concession Road H-I, occupied by Rama Public School and Fire Station 3.)

The distribution of non-residential PRE jobs was then estimated using the share of occupied lands in each settlement area. Applying the percentages shown in Table 3 to the totals for the Township estimated above gives a total of 437 non-residential PRE jobs in Lagoon City (378 Commercial PRE jobs and 59 Institutional PRE jobs) and 574 non-residential PRE jobs in Brechin (169 Commercial PRE jobs, 293 Institutional PRE jobs, and 111 Industrial PRE jobs). When added to the estimated

[5] For a full breakdown, see the table in Appendix “B”. The “Utilities” category has been included as “Institutional PRE” because the parcels in Lagoon City and Brechin occupied by these types of uses are not identified as employment lands in the 2017 Employment Land Budget.

[6] This number differs from the number of PRE jobs identified in the Simcoe County MCR employment forecasts, which is because the estimate presented here is based on fairly broad “industry” categories (some of which likely include a combination of PRE, ELE, and even Rural Employment jobs).

Table 3 – Occupied commercial, institutional, and employment lands in Ramara Township

	Occupied Commercial Lands		Occupied Institutional Lands		Occupied Employment Lands	
Settlement Area	**Area [ha]**	**%**	**Area [ha]**	**%**	**Area [ha]**	**%**
Atherley-Uptergrove	13.943	36.2	11.077	37.2	0.116	0.3
Brechin	5.823	15.1	8.785	29.5	10.321	29.8
Cooper's Falls	1.106	2.9	---	--	---	--
Gamebridge	---	--	1.054	3.5	---	--
Lagoon City	12.991	33.7	1.782	6.0	---	--
Longford Mills	0.779	2.0	1.626	5.5	8.390	24.2
Sebright	0.215	0.6	0.511	1.7	---	--
Udney	0.479	1.2	---	--	---	--
Washago	1.280	3.3	---	--	1.421	4.1
(Rural Area)	1.890	4.9	4.979	16.7	14.379	41.5
Totals	**38.505**	**100.0**	**29.814**	**100.0**	**34.628**	**100.0**

number of Residential PRE jobs, we have a combined **total of 1,107 PRE jobs** across the two settlement areas: 96 Residential PRE jobs, 547 Commercial PRE jobs, 353 Institutional PRE jobs, and 111 Industrial PRE jobs. (For the two settlement areas, this works out to a rate of about 0.695 PRE jobs per person in 2021.)

Employment-Land Employment

According to the most recent forecasts prepared by Hemson for Simcoe County's MCR, there were 330 "Employment Land Employment" ("ELE") jobs in Ramara in 2021.

The results of the parcel survey, summarized in Table 3 above, indicate that there is a total of approximately 34.63 ha of occupied employment lands in Ramara Township (including those portions of "underutilized" parcels that are occupied in some manner), of which 10.32 ha, or about 30%, is located in Brechin. If we continue in our assumption of an average employment density across all employment lands in the Township, then we estimate **a total of 99 ELE jobs** in Brechin in 2021.

Summary of Baseline Estimates

The previous two sections have provided us with the following population and employment estimates for 2021 that will serve as the "baseline" scenario for the development forecast:

- a total population of 1,593 permanent residents in the two settlement areas (1,381 people living in Lagoon City and 212 people living in Brechin);
- a total of 1,146 dwelling units (1,051 units in Lagoon City and 95 in Brechin), of which 779 units are occupied by usual (i.e., permanent) residents (692 such units in Lagoon City and 87 in Brechin);
- a total of 1,486 permanent residents living in the "serviced area" (approximately 1,264 people in Lagoon City, 202 people in Brechin, and 20 people in the "OPA 17" area);
- an estimated total of 1,036 dwelling units in the serviced area (about 934 in Lagoon City, 90 in Brechin, and 12 in the "OPA 17" area), of which an estimated 729 are occupied by permanent residents (about 636 in Lagoon City, 83 in Brechin, and 10 in the "OPA 17" area)
- a total of 750 occupied residential lots in the two settlement areas, 8 of which can be considered "underutilized" — 661 occupied lots (1 underutilized) in Lagoon City and 89 occupied lots (7 underutilized) in Brechin — as well as an additional 12 occupied residential lots (3 underutilized) in the "OPA 17" area;
- a total of 630 occupied residential lots in the serviced area: 529 in Lagoon City (none of which are considered underutilized), 89 in Brechin (7 underutilized), and the same 12 occupied lots (3 underutilized) in the "OPA 17" area; and
- total employment of 1,219 jobs in the two settlement areas: 533 PRE jobs in Lagoon City, 587 PRE jobs in Brechin, and 99 ELE jobs in Brechin.

Population & Employment Growth Forecasts

Table 4 shows the most recent forecasts for population, housing, and employment growth in Ramara Township for 2021–2051, prepared by Hemson in support of Simcoe County's MCR. Table 4 only includes the projected number of population-related employment ("PRE") jobs and employment-land employment ("ELE") jobs: again, because rural employment jobs are, by definition, located outside settlement areas, they have been omitted from the table and from the discussion moving forward. Three of the columns in Table 4 present values derived from the County's forecasts: the average annual population growth rate over each five-year period, the average household size (population divided by number of occupied dwelling units), and the "PRE rate," which is the number of PRE jobs divided by the population. As the derived values show, the average household size in the Township is projected to decrease over the next thirty years, as is the PRE rate. (For the purposes of forecasts made beyond 2051, we will assume that the Township's population will continue to grow at an average annual rate of 0.60%, with the average household size holding steady at 2.15 people per unit and the PRE rate also remaining constant at 0.275 PRE jobs per person.)

Table 4 – Population and employment forecasts for Ramara Township, 2021–2051

Year	Population	Avg. annual growth rate	Occupied dwelling units	Avg. house-hold size	PRE jobs	PRE rate [jobs / pers.]	ELE jobs
2021	10,680	---	4,410	2.42	3,130	0.293	330
2026	11,120	0.81%	4,720	2.36	3,230	0.290	450
2031	11,550	0.76%	5,010	2.31	3,320	0.287	530
2036	11,890	0.58%	5,280	2.25	3,380	0.284	690
2041	12,150	0.43%	5,510	2.21	3,430	0.282	860
2046	12,500	0.57%	5,730	2.18	3,510	0.281	1,110
2051	12,870	0.59%	5,940	2.17	3,580	0.278	1,300

The County's growth forecasts will provide the basis for determining the "build-out" year for development in Lagoon City and Brechin — that is, the total number of potential dwelling units in these two settlement areas will translate into the total potential population, based on the number of dwelling units that we expect will be occupied by permanent (i.e., non-seasonal) residents and on the average number of people per occupied dwelling unit. From there, we can use the number of people living in Lagoon City and Brechin to estimate the total population for Ramara Township and, thus, the corresponding year based on County forecasts. To do so, however, we must answer one further question: How much of the population growth projected for the Township should be allocated to the settlement areas of Lagoon City and Brechin?

Since 2006, the Township of Ramara has seen its overall population grow by 905 people, from a population of 9,775 people in the 2006 Census (adjusted for net under-coverage) to 10,680 people in 2021 (according to the most recent MCR forecasts). Our population estimates suggest that about 22% of that growth, or 200 people out of the total 905 people, has occurred in either Lagoon City or Brechin (but mostly in Lagoon City). According to the population estimates presented above, another 34.5% of the Township's population growth between 2006 and 2021 took place in Atherley-Uptergrove, which saw an increase of about 312 people, while a negligible percentage (somewhere between 0.1% and 0.2%) occurred in Longford Mills.

This means that, taken together, the four Villages accommodated around 57% of the population growth in the Township between 2006 and 2021. For the purposes of estimating population figures beyond 2021, we will therefore assume that 60% of the Township's overall population growth will be directed to the four Villages, and we will further assume that 40% of the growth directed to the Villages (or 24% of the Township's total) will occur in either Lagoon City or Brechin.

For present purposes, population growth is a function of the total number of dwelling units, the percentage of those units that are occupied by “usual residents” (referred to in this memo as “occupancy rate”), and the average household size:

$$\Delta P = hR \cdot \Delta u \ ,$$

where ΔP is the change in population, h is the average household size (in people per unit), R is the occupancy rate (as a percentage), and Δu is the change in the total number of dwelling units.

As noted earlier (see p. 5), occupancy rate and average household size differ significantly between Lagoon City and Brechin. **Table 5** shows these values for the two settlement areas from 2006 to 2021, based on estimates derived from Census data. The occupancy rate in Lagoon City is much lower than it is in Brechin, which reflects the much higher seasonal population in the former, while the average household size in Brechin is consistently higher than it is in Lagoon City.

Average household size in Brechin in 2016 and 2021 has been very similar to the overall Township average — in 2021, the average was 2.44 people per unit in Brechin and 2.42 people per unit for the Township overall — whereas the average household size in Lagoon City has been lower, generally about 80% of the Township average. Moving forward, therefore, we will assume that average household size in Brechin will remain the same as it is for the Township overall, and we will further assume that household size in Lagoon City remains at a constant percentage of the Township average. If we express the Township average as h_T and the averages in Lagoon City and Brechin as h_L and h_B, respectively, then:

$$h_B = h_T \ \text{ and } \ h_L = k \cdot h_T \ ,$$

where k is some constant of proportionality (based on Census data from 2006 to 2021, we will assume that $k \approx 0.8$). We will further assume that the occupancy rate in the two settlement areas, expressed as R_L and R_B, will also remain constant, such that $R_L = 0.66$ and $R_B = 0.90$ (again, based on recent Census data).

Table 5 – Occupancy rates and average household sizes, 2006–2021

	Lagoon City					Brechin				
Year	Popul’n	Total dw.	Occ’d dw	Occup. rate	Avg. hhld size	Popul’n	Total dw.	Occ’d dw.	Occup. rate	Avg. hhld size
2006	1,183	1,024	569	55.6%	2.08	210	92	76	82.6%	2.76
2016	1,227	1,039	621	59.8%	1.98	206	95	84	88.4%	2.45
2021	1,381	1,051	692	65.8%	2.00	212	95	87	91.2%	2.44

If we similarly express the change in the total number of dwelling units in Lagoon City and in Brechin as Δu_L and Δu_B, respectively, and population growth in the two as ΔL and ΔB, then we have:

$$\Delta L = k \cdot h_T R_L \cdot \Delta u_L \quad \text{and} \quad \Delta B = h_T R_B \cdot \Delta u_B$$

The variables Δu_L and Δu_B, which are related to the total unit potential in the two settlement areas, require a more complex set of assumptions than the others.

Potential Dwelling Units

The total number of dwelling units that could potentially be accommodated in the settlement areas of Lagoon City and Brechin is estimated based on four values:

- the number of existing vacant residential lots;
- the number of "underutilized" residential lots;
- the number of dwelling units in approved plans of subdivision; and
- the number of units that can be accommodated on developable vacant residential lands.

Vacant & Underutilized Residential Lots

Parcel data obtained from the Township, combined with a visual survey based on aerial photographs, indicate that there are 114 vacant residential lots in Lagoon City (55 of which are located in the serviced area) and another 8 vacant residential lots in Brechin, as well as one more in the serviced OPA 17 area. "Vacant residential lot" here means a lot whose size is appropriate for a single detached dwelling that is zoned to permit residential uses and that is unoccupied by buildings or structures — in fact, three of these vacant lots (two in Lagoon City and one in Brechin) are able to support two dwelling units. For present purposes, the term "underutilized residential lot" refers to a residential lot that is occupied by a dwelling but that is large enough either to accommodate an additional detached residential unit or to allow for another separate residential lot to be created by consent to sever. A visual survey suggests that there are 32 such lots in Lagoon City (15 of them in the serviced area) and 14 in Brechin, as well as one more in the OPA 17 area. Vacant and underutilized residential lots are identified in **Figure 3**.

Furthermore, there are four occupied but underutilized commercial lots (two in Lagoon City and two in Brechin) and one occupied underutilized institutional lot (in Brechin) from which an additional residential lot could be created by consent (also identified in Figure 3). At the same time, there are three lots in Brechin that are zoned as "Commercial" but that are presently occupied by dwellings. Assuming that, in the long term, these commercially zoned lots will be occupied by commercial uses, this gives us another two potential dwelling units (five new residential lots minus three dwellings converted to commercial uses).

The number of existing vacant and underutilized residential lots thus gives us the potential for another 157 dwelling units in Lagoon City (116 on vacant lots, 39 on underutilized residential lots, and 2 on lots that could be severed from underutilized commercial lots), of which 71 are located in the serviced area (55 vacant lots, 15 underutilized residential lots, and one of the underutilized

FIGURE 3
VACANT AND UNDERUTILIZED LOTS

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1: 20,000

0 200 400 800

Meters

DRAWN BY: MN

SOURCE:
Township of Ramara (2022)
GSP Group (2022)

GSP group

commercial lots). We also have the potential for another 25 dwelling units in Brechin (9 on vacant lots and 16 on underutilized residential lots; the two underutilized commercial lots and one underutilized institutional lot are "canceled" out by the three dwellings located on commercially zoned lots).

Units in Approved Plans of Subdivision

At present, there is one approved plan of subdivision that proposes development in these two settlement areas, that being the "Brechin Subdivision" (**Figure 4**), which primarily consists of the parcel known by the municipal address of 2123 Concession Road 4, located on the south side of Concession Road 4 east of Church Street in Brechin. (To be precise, the plan of subdivision includes 26.763 hectares of this parcel's total area of 27.103 hectares. A small, irregularly shaped strip of land measuring 0.340 hectares, is identified as part of the "additional lands owned by the applicant" shown on the draft plan.) The Brechin Subdivision would also incorporate six existing residential parcels (Nos. 2099, 2107, 2117, 2131, 2141, and 2151 Concession Road 4), all of which are vacant.

According to the draft plan, Phase 1 of the Brechin Subdivision will consist of 54 single detached dwellings, 20 semi-detached dwellings, and 21 townhouse dwellings on a combined total of about 3.32 hectares. At 74 units on about 2.840 hectares of land, the "low-density" unit types (single and semi-detached) have an average density of 26.06 units per hectare; the four townhouse blocks have a combined area of about 0.477 hectares, which gives an average density of 44.03 units per hectare. Overall, Phase 1 contains a total of 95 dwelling units at an average density of 28.64 units per hectare.

Future phases of the Brechin Subdivision comprise a total of twelve "low-density" blocks (with 300 planned units on an area of 11.920 hectares for an average of 25.17 units per hectare), and one "medium-density" block (with 36 units on 1.841 hectares, giving an average of 19.55 units per hectare).

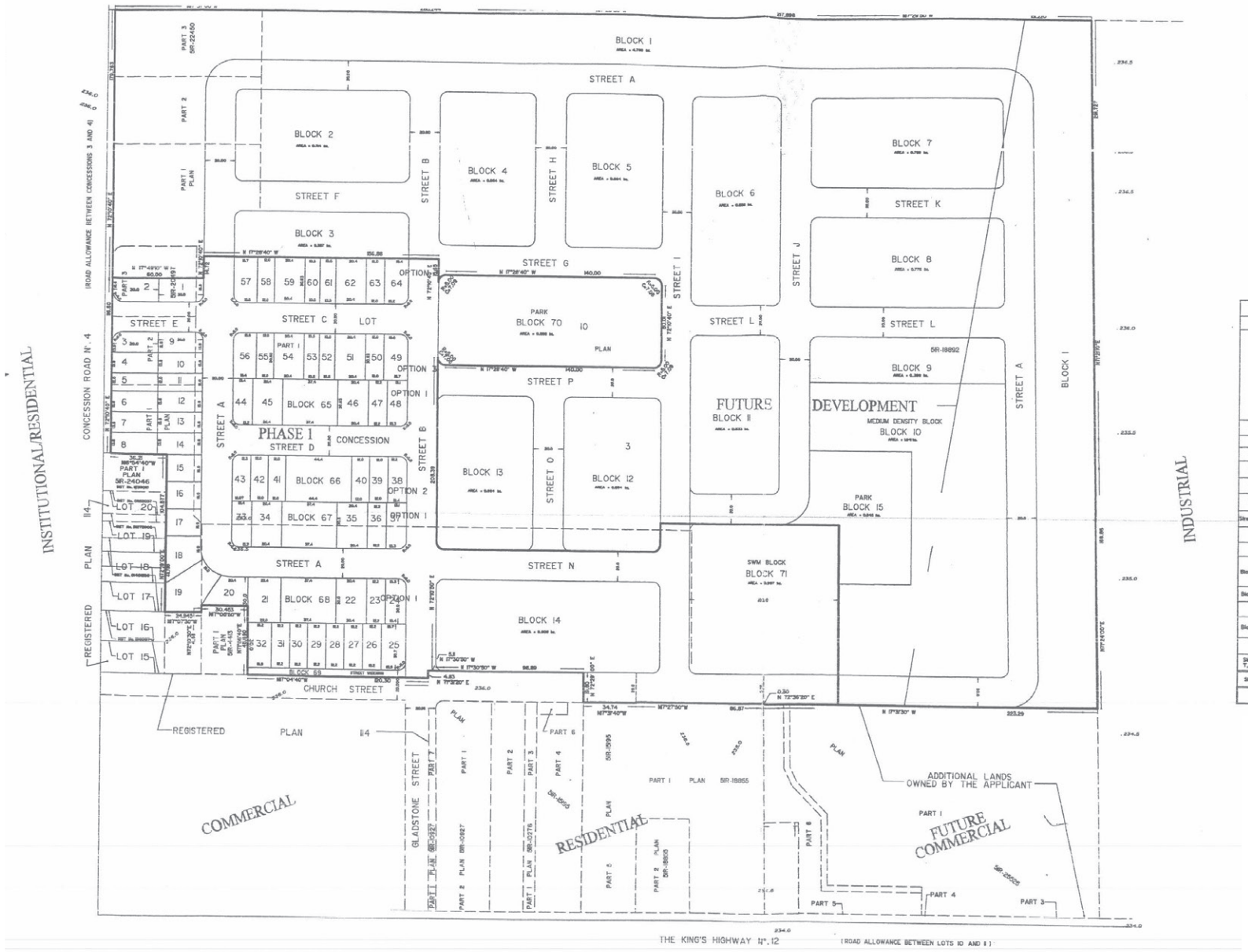
Once fully built, the Brechin Subdivision will contain a total of 431 dwelling units: 57 townhouse units and 374 single detached and semi-detached units. In terms of percentages, the planned single detached and semi-detached dwellings represent 86.8% of the planned units, with townhouse units comprising the remaining 13.2% of units.

Added to the 25 potential dwelling units on vacant or underutilized lands, the 431 units in the Brechin Subdivision gives us a total of 456 potential units in the Brechin settlement area.

Vacant Developable Residential Lands

The remaining parcels of land that could potentially accommodate residential development (shown in **Figure 5**) occupy approximately 95.18 hectares: 45.61 hectares in Lagoon City and 49.57 hectares in Brechin.[7] However, the distribution of developable land is not as even as these numbers would

[7] One of these parcels is 30 Paradise Boulevard, located at the northerly end of the Lagoon City settlement area, which has a total area of 197.29 hectares but of which only 11.83 hectares is located within the settlement area boundaries. The value of 45.61 hectares for Lagoon City given here includes only the 11.83 hectares within the settlement area.



Lot/Blk No.	Land Use	Units	Area (hectares)	Area (acres)
1 to 64	15.0m (50') Single Family	6		
	13.8m (45') Single Family	8		
	12.0m (40') Single Family	2		
	10.5m (35') Single Family	4		
	Semi Detached	30		
	TOTAL NUMBER OF UNITS	74	2.840 ha	7.08 ac
Blocks 65, 66, 67 and 68	Town Houses	21	0.677 ha	1.73 ac
SUBTOTAL		95	3.37 ha	8.81 ac
Block 14	Future Low Density Residential Block		0.906 ha	2.24 ac
Block 69	Street Widening		0.032 ha	0.09 ac
Block 70	Park		0.895 ha	2.23 ac
Block 71	Sem. Pond		0.997 ha	2.46 ac
Streets - (Street 'A', 'B', 'C', 'D' 'E' and 'F')	Length of Streets	1760.50 m	2.646 ha	6.538 ac
SUBTOTAL (PHASE I)		95	8.886 ha	21.790 ac
Blocks 1-9 and 11-13	Future Low Density Residential Blocks	300	8.92 ha	20.455 ac
Block 10	Future Medium Density Residential Block	36	1.846 ha	4.549 ac
SUBTOTAL			13.763 ha	34.009 ac
Block 15	Park	-	0.545 ha	1.347 ac
Streets - (Street 'A', 'B', 'F', 'G', 'H', 'I', 'J', 'K', 'L', 'N' and 'P')	Length of Streets	2403.5 m	5.736 ha	14.174 ac
SUBTOTAL (Future Development)		336	20.044 ha	49.530 ac
TOTAL		431	28.864 ha	71.325 ac

FIGURE 4
BRECHIN SUBDIVISION PLAN

SOURCE:
J.D. Barnes Limited

FIGURE 5
VACANT RESIDENTIAL PARCELS

1: 30,000

0 250 500 1,000

Meters

DRAWN BY: MN

SOURCE:
Township of Ramara (2022)
GSP Group (2022)

GSP group

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suggest. The vacant parcels in Lagoon City are significantly constrained by the presence of natural heritage features — of the 45.61 vacant hectares, only about 4.46 hectares is unconstrained, whereas Brechin has about 39.45 hectares of unconstrained vacant land (just under 80% of the total 49.57 hectares). It should also be noted that the vacant parcels in Brechin are not entirely vacant: three of them contain a single detached dwelling unit, which will need to be subtracted from the final total.

Translating this remaining vacant area into the number of potential units depends on two factors:

- What will the average density (in units per gross hectare) be for residential development on these remaining lands?
- How much of the constrained area can be considered "developable"?

Table 6 shows nine different scenarios based on different assumptions about the answers to these two questions. The three columns represent three "density scenarios," each corresponding to a different average density (20, 30, and 40 units per hectare), while each set of rows represents a different "development" scenario, each of which uses a different assumption about how much constrained area can be considered "developable." Because the majority of environmentally constrained lands are located in Lagoon City, the three development scenarios have a greater effect on the number of potential units in that settlement area.

In mathematical terms, if we use ρ to represent the average unit density (units per hectare) and q for the percent of constrained lands that is considered developable, then the total number of units in each scenario is given by the expression:

$$\rho\,(U_L + q \cdot C_L) + \rho\,(U_B + q \cdot C_B) - 3\ ,$$

Table 6 – Scenarios for development of remaining vacant lands

Development Scenario	Density Scenario					
	Low – 20 units/ha		Medium – 30 units/ha		High – 40 units/ha	
Low (0%)	Lagoon City	89	Lagoon City	134	Lagoon City	179
	Brechin	811	Brechin	1,217	Brechin	1,624
	Total	900	Total	1,351	Total	1,803
Medium (25%)	Lagoon City	295	Lagoon City	442	Lagoon City	590
	Brechin	861	Brechin	1,293	Brechin	1,725
	Total	1,156	Total	1,735	Total	2,315
High (50%)	Lagoon City	501	Lagoon City	751	Lagoon City	1,001
	Brechin	912	Brechin	1,369	Brechin	1,827
	Total	1,413	Total	2,120	Total	2,828

where U_L and U_B to represent the unconstrained developable area in Lagoon City and Brechin, respectively, and C_L and C_B represent the total area of vacant land in each settlement area that is environmentally constrained (all in hectares). The "– 3" at the end accounts for the three existing dwellings located on otherwise vacant developable parcels in Brechin.

Two of the vacant parcels in Lagoon City (known by the municipal addresses of 83 and 85 Simcoe Road) are not located adjacent to the existing sanitary main and are therefore not considered to be within the "serviced" area. These two parcels have a total combined area of 16.50 hectares, of which 1.21 hectares are unconstrained. Using the same set of values as in Table 6, we arrive at the set of values for potential serviced and unserviced units in Lagoon City shown in **Table 7** (some values do not add up exactly due to rounding).

Putting all of this together gives us the set of values presented in **Table 8** (p. 22), which combines the number of potential units on vacant and underutilized residential lots in the two settlement areas, the total number of units in the Brechin Subdivision, and the potential units according to the nine scenarios presented in Table 6 and Table 7. Table 8 provides two separate values for the number of units in Lagoon City: the first is the total number of dwelling units in the settlement area, and the second value (in parentheses) is the number of units located in the serviced area.

Build-Out Population & Year

We have already established that, of the Township's total population growth, ΔP, a certain percentage, expressed as a, is allocated to the settlement areas of Lagoon City and Brechin, such that $\Delta L + \Delta B = a \cdot \Delta P$. We are further assuming that a = 0.24 (that is, 40% of the 60% of the Township's population growth that we assume is allocated to the four Villages — see p. 13). Our estimates of the total unit potential allow us to determine the overall ratio of the number of new dwelling units in Brechin to the number of new units in Lagoon City, expressed as D: that is, for every dwelling unit constructed in Lagoon City, we assume that D units are constructed in Brechin. The specific value of D varies depending on the density and development scenarios chosen, from 4.63 in the high-density, low-development scenario to 1.78 in the low-density, high-development scenario.

Table 7 – Potential serviced and unserviced units in Lagoon City by scenario

Development Scenario	Density Scenario					
	Low – 20 units/ha		Medium – 30 units/ha		High – 40 units/ha	
Low (0%)	serviced	65	serviced	98	serviced	130
	unserviced	24	unserviced	36	unserviced	48
Medium (25%)	serviced	194	serviced	292	serviced	389
	unserviced	101	unserviced	151	unserviced	201
High (50%)	serviced	324	serviced	486	serviced	647
	unserviced	177	unserviced	266	unserviced	354

Table 8 – Total potential dwelling units by scenario

Devpmt Scenario	Density Scenario		
	Low – 20 units/ha	Medium – 30 units/ha	High – 40 units/ha
Low (0%)	Lagoon City 246 (136) Brechin 1,267 Total 1,513 (1,403)	Lagoon City 291 (169) Brechin 1,673 Total 1,964 (1,842)	Lagoon City 336 (201) Brechin 2,080 Total 3,416 (2,281)
Medium (25%)	Lagoon City 452 (265) Brechin 1,317 Total 1,769 (1,582)	Lagoon City 599 (363) Brechin 1,749 Total 2,348 (2,112)	Lagoon City 747 (460) Brechin 2,181 Total 2,928 (2,641)
High (50%)	Lagoon City 658 (395) Brechin 1,368 Total 2,026 (1,763)	Lagoon City 908 (557) Brechin 1,825 Total 2,733 (2,382)	Lagoon City 1,158 (718) Brechin 2,283 Total 3,441 (3,001)

Combining the value of the development ratio D with our assumed values for average household size and occupancy rates, we can express the population growth in each settlement area in terms of the Township's population growth:

$$\Delta L = \frac{k \cdot R_L}{k \cdot R_L + R_B D} a \cdot \Delta P \quad \text{and} \quad \Delta B = \frac{R_B D}{k \cdot R_L + R_B D} a \cdot \Delta P ,$$

where R_L and R_B are the occupancy rates in Lagoon City and Brechin and k is the proportion of average household size in Lagoon City as compared to Brechin (see p. 14). The full derivation of these two equations is provided in **Appendix "C"**.

Using these two equations, **Table 9** (p. 23) shows estimated population growth in five-year increments for three different scenarios. Each scenario sees the combined population of Lagoon City and Brechin growing by 526 people between 2021 and 2051 (which is 24% of the Township's overall growth of 2,190 people) to a combined total of 2,119 people.

Although the average household size changes over time (see Table 5), the lowest growth scenario considered sees a total of 1,513 dwelling units added to Lagoon City and Brechin, meaning that full build-out can be expected to occur well beyond 2051. This is confirmed by the numbers shown in **Table 10** (p. 23), which gives the total number of dwelling units (not just those occupied by usual residents) added in each scenario. The greatest number of units is actually added in the low-density (20 units per hectare), high-development (50% of constrained area is considered developable), a combination of the lower occupancy rate in Lagoon City and the greater amount of developable land in Brechin.

Table 9 – Population growth in Lagoon City and Brechin under three scenarios

Year	Township population	High density, low development (*D* = 6.19)		Medium density, medium development (*D* = 2.92)		Low density, high development (*D* = 2.08)	
		Lagoon City	Brechin	Lagoon City	Brechin	Lagoon City	Brechin
2021	10,680	1,381	212	1,381	212	1,381	212
2026	11,120	1,390	308	1,399	300	1,404	294
2031	11,550	1,399	403	1,416	386	1,427	375
2036	11,890	1,406	477	1,430	454	1,445	438
2041	12,150	1,412	534	1,440	506	1,459	487
2046	12,500	1,419	611	1,454	576	1,477	553
2051	12,870	1,426	692	1,469	650	1,497	622

Table 10 – Total number of added dwelling units by population scenario

Year	High density, low development (*D* = 6.19)			Medium density, medium development (*D* = 2.92)			Low density, high development (*D* = 2.08)		
	LC	Brechin	Total	LC	Brechin	Total	LC	Brechin	Total
2026	7	45	53	14	41	56	19	39	58
2031	15	91	106	28	83	111	37	78	115
2036	21	128	148	40	116	156	52	109	161
2041	25	156	182	49	143	191	64	134	198
2046	32	196	227	61	178	239	80	167	247
2051	38	237	275	74	216	290	97	202	300

The low-density, high-development scenario projects the construction of 300 total dwelling units in the two settlement areas by 2051, which still leaves another 1,726 total units (1,166 in Brechin and 561 in Lagoon City) before full build-out is achieved under this scenario (the numbers do not add up exactly because of rounding). For Brechin, assuming an average household size of 2.15 people per occupied unit beyond 2051 and the same occupancy rate of 90%, this translates into an additional 2,255 permanent residents beyond 2051, bringing the total population of Brechin to 2,877 people. Similarly, an average household size of 1.72 people per unit in Lagoon City (2.15 people per unit × our proportionality constant $k = 0.8$) and an occupancy rate of 66% gives an additional 636 permanent residents beyond 2051, for a total of 2,133 people living in Lagoon City.

The combined build-out population of 5,010 people in the two settlement areas represents growth of 2,892 people beyond 2051. Assuming that this is still 24% of the Township's overall population growth, we therefore have a total of 24,919 people living in Ramara Township (the projected 2051 population of 12,870 people plus an additional 12,049 people). At an average annual growth rate of 0.60%, a Township population of 24,919 people corresponds to a build-out year of 2162.

Table 11 – Build-out year by scenario

Devpmt Scenario		Density Scenario Low (20 units/ha)	Medium (30 units/ha)	High (40 units/ha)
Low	Units added beyond 2051	1,235 (201+1,034)	1,687 (250+1,437)	2,141 (298+1,843)
(0%)	Population growth beyond 2051	2,229 (228+2,001)	3,065 (284+2,781)	3,904 (338+3,566)
	Total Township population	22,156	25,642	29,137
	Build-out year	2142	2167	2188
Medium	Units added beyond 2051	1,479 (378+1,101)	2,058 (525+1,533)	2,638 (673+1,965)
(25%)	Population growth beyond 2051	2,559 (429+2,130)	3,562 (596+2,966)	4,566 (764+3,802)
	Total Township population	23,533	27,712	31,895
	Build-out year	2152	2180	2203
High	Units added beyond 2051	1,726 (561+1,166)	2,432 (808+1,624)	3,139 (1,057+2,083)
(50%)	Population growth beyond 2051	2,892 (636+2,255)	4,060 (917+3,143)	5,230 (1,199+4,031)
	Total Township population	24,919	29,786	34,661
	Build-out year	2162	2192	2217

(For comparison, the medium-density, medium-development scenario gives a build-out year of 2180 and the high-density, low-development scenario a build-out year of 2188.) **Table 11** shows build-out estimates for the nine scenarios considered in earlier tables; individual estimates for Lagoon City and Brechin are given in parentheses.

Based on the density of existing development, combined with the proposed densities for development in the Brechin Subdivision, **the likeliest scenarios are the low-density and medium-density scenarios with development being permitted on 25% of constrained lands**, which at current growth rates gives **a build-out year** sometime in the second half of the 22nd century, **between 2167 and 2180**.

"Fast-Growth" Scenarios

The projections made up to this point have been based on the assumption that overall population growth in Lagoon City and Brechin will be fairly slow, as reflected in recent Census data. However, the amount of development that has already been approved or that is planned for the future, primarily in Brechin, suggests that it might be appropriate to look at scenarios that assume a more accelerated pace of growth.

Table 12 (p. 25) presents the same set of nine scenarios (low-density, medium-density, and high-density, with development at each density using 0%, 25%, and 50% of constrained vacant residential lands) under the assumption that a greater percentage of Ramara Township's population growth will be directed to Lagoon City and Brechin — namely, that 80% of overall population growth will be directed to the Township's four Villages, and that, of that 80%, 60% will be directed either to

Table 12 – Build-out scenarios under "fast-growth" assumptions

Devpmt Scenario		Density Scenario Low (20 units/ha)	Medium (30 units/ha)	High (40 units/ha)
Low	Population (2051)	2,644 (1,488+1,113)	2,644 (1,478+1,166)	2,644 (1,472+1,172)
(0%)	Total dwelling units (2051)	1,703 (1,141+561)	1,699 (1,133+566)	1,697 (1,128+569)
	Units added beyond 2051	956 (156+801)	1,411 (209+1,202)	1,865 (259+1,606)
	Popul'n growth beyond 2051	1,872 (177+1,550)	2,563 (237+2,326)	3,402 (294+3,107)
	Total Township population	16,467	18,210	19,957
	Build-out year	2082	2095	2107
Medium	Population (2051)	2,644 (1,557+1,087)	2,644 (1,557+1,087)	2,644 (1,557+1,087)
(25%)	Total dwelling units (2051)	1,726 (1,199+527)	1,726 (1,199+527)	1,726 (1,199+527)
	Units added beyond 2051	1,189 (304+885)	1,768 (451+1,317)	2,348 (599+1,749)
	Popul'n growth beyond 2051	2,057 (345+1,712)	3,060 (512+2,548)	4,064 (680+3,384)
	Total Township population	17,155	19,245	21,336
	Build-out year	2088	2102	2115
High	Population (2051)	2,644 (1,612+1,032)	2,644 (1,619+1,026)	2,644 (1622+1,022)
(50%)	Total dwelling units (2051)	1,746 (1,246+500)	1,748 (1,251+497)	1,749 (1,254+495)
	Units added beyond 2051	1,426 (463+963)	2,131 (708+1,423)	2,838 (955+1,883)
	Popul'n growth beyond 2051	2,390 (526+1,864)	3,558 (804+2,754)	4,728 (1,084+3,643)
	Total Township population	17,848	20,282	22,719
	Build-out year	2093	2109	2123

Lagoon City or Brechin, meaning that just under half (48%) of the Township's population growth is now allocated to these two settlement areas. This increased allocation gives a combined population of 2,644 people living in Lagoon City and Brechin by 2051, although the distribution of that population between the two varies by scenario. The scenarios presented in Table 12 also assume a slightly faster growth rate for the Township's population beyond 2051, with an average annual rate of 0.8% instead of 0.6%. (The value of 0.8% is the average annual rate of population growth from 2021 to 2026, according to Simcoe County's MCR forecasts.)

Under this new set of assumptions, the likeliest scenarios (development at either 20 or 30 units per hectare using 25% of the total constrained area) project **full build-out** around the turn of the 22nd century, **between 2095** in the lower-density scenario **and 2102** in the medium-density scenario. This is significantly earlier than the projections under the low-growth scenarios (which projected build-out between 2167 and 2180), although still well beyond 2051.

If you have any questions about the estimates and projections provided in this memorandum, or about the methodology used to arrive at these findings, please feel free to contact me (Patrick Casey) at GSP Group.

Yours truly,

GSP Group

/ Appendices

Appendix "A"
Population and Dwelling Counts by Census Dissemination Block, 2006–2021

Population and Dwelling Counts by Dissemination Block (DB), 2006 Census of Population

DB ID No.	DB population	Total dwellings in DB	Dwellings in DB occupied by usual residents	DB within Settlement Area?	Estimated % of DB popul'n within Settlement Area	Estimated DB population in Settlement Area	Estimated total dwellings in Settlement Area	Estimated occupied dwellings in Settlement Area
Lagoon City								
1246-01	200	216	105	Fully	1.00	200	216	105
1246-02	540	526	260	Partially	0.71	382	372	184
1247-01	96	67	49	Fully	1.00	96	67	49
1247-02	74	53	38	Fully	1.00	74	53	38
1247-03	327	274	167	Fully	1.00	327	274	167
1248-03	43	32	19	Partially	0.94	40	30	18
1248-04	22	12	8	Fully	1.00	22	12	8
					Totals, Lagoon City (2006)	**1,141**	**1,024**	**569**
Brechin								
1245-07	114	42	38	Partially	0.81	92	34	31
1245-09	35	14	12	Fully	1.00	35	14	12
1246-02	540	526	260	Partially	0.03	18	18	9
1248-01	21	9	8	Fully	1.00	21	9	8
1248-02	18	12	10	Partially	0.08	2	1	1
1249-14	33	8	8	Partially	0.00	0	0	0
1249-15	5	1	1	Fully	1.00	5	1	1
1249-16	29	15	15	Fully	1.00	29	15	15
					Totals, Brechin (2006)	**202**	**92**	**76**
					Totals, Lagoon City & Brechin (2006)	**1,343**	**1,116**	**645**

Population and Dwelling Counts by Dissemination Block (DB), 2016 Census of Population

DB ID No.	DB population	Total dwellings in DB	Dwellings in DB occupied by usual residents	DB within Settlement Area?	Estimated % of DB popul'n within Settlement Area	Estimated DB population in Settlement Area	Estimated total dwellings in Settlement Area	Estimated occupied dwellings in Settlement Area
Lagoon City								
1246-003	132	131	76	Fully	1.00	132	131	76
1246-007	42	51	25	Partially	1.00	42	51	25
1246-010	334	245	185	Partially	0.88	294	216	163
1246-011	10	5	4	Partially	0.00	0	0	0
1246-013	68	69	29	Fully	1.00	68	69	29
1246-014	58	96	30	Fully	1.00	58	96	30
1246-015	20	28	10	Fully	1.00	20	28	10
1246-016	5	1	1	Fully	1.00	5	1	1
1246-017	23	17	10	Fully	1.00	23	17	10
1247-001	103	69	52	Fully	1.00	103	69	52
1247-004	398	328	203	Fully	1.00	398	328	203
1248-003	36	24	17	Partially	0.96	35	23	16
1248-004	16	10	6	Fully	1.00	16	10	6
				Totals, Lagoon City (2016)		**1,194**	**1,039**	**621**

DB ID No.	DB population	Total dwellings in DB	Dwellings in DB occupied by usual residents	DB within Settlement Area?	Estimated % of DB popul'n within Settlement Area	Estimated DB population in Settlement Area	Estimated total dwellings in Settlement Area	Estimated occupied dwellings in Settlement Area
Brechin								
1245-007	103	41	40	Partially	0.83	85	34	33
1245-009	30	15	12	Fully	1.00	30	15	12
1246-010	334	245	185	Partially	0.09	31	23	17
1248-001	15	7	7	Fully	1.00	15	7	7
1248-002	18	8	7	Partially	0.13	2	1	1
1249-014	27	8	8	Partially	0.00	0	0	0
1249-015	0	0	0	Fully	1.00	0	0	0
1249-016	36	15	14	Fully	1.00	36	15	14
					Totals, Brechin (2016)	**200**	**95**	**84**
					Totals, Lagoon City & Brechin (2016)	**1,394**	**1,134**	**706**

Population and Dwelling Counts by Dissemination Block (DB), 2021 Census of Population

DB ID No.	DB population	Total dwellings in DB	Dwellings in DB occupied by usual residents	DB within Settlement Area?	Estimated % of DB popul'n within Settlement Area	Estimated DB population in Settlement Area	Estimated total dwellings in Settlement Area	Estimated occupied dwellings in Settlement Area
Lagoon City								
1246-003	153	133	86	Fully	1.00	153	133	86
1246-007	51	56	31	Partially	1.00	51	56	31
1246-010	402	245	205	Partially	0.88	354	216	181
1246-011	15	8	6	Partially	0.00	0	0	0
1246-013	66	68	29	Fully	1.00	66	68	29
1246-014	65	97	36	Fully	1.00	65	97	36
1246-015	24	28	12	Fully	1.00	24	28	12
1246-016	5	1	1	Fully	1.00	5	1	1
1246-017	28	18	15	Fully	1.00	28	18	15
1247-001	101	70	49	Fully	1.00	101	70	49
1247-004	434	327	224	Fully	1.00	434	327	224
1248-003	40	26	19	Partially	0.96	38	25	18
1248-004	22	12	10	Fully	1.00	12	22	10
				Totals, Lagoon City (2021)		**1,342**	**1,051**	**692**

DB ID No.	DB population	Total dwellings in DB	Dwellings in DB occupied by usual residents	DB within Settlement Area?	Estimated % of DB popul'n within Settlement Area	Estimated DB population in Settlement Area	Estimated total dwellings in Settlement Area	Estimated occupied dwellings in Settlement Area
Brechin								
1245-007	111	41	38	Partially	0.83	92	34	32
1245-009	28	13	12	Fully	1.00	28	13	12
1246-010	402	245	205	Partially	0.10	39	24	20
1248-001	10	7	7	Fully	1.00	10	7	7
1248-002	17	8	6	Partially	0.13	2	1	1
1249-014	25	7	7	Partially	0.00	0	0	0
1249-015	0	1	1	Fully	1.00	0	1	1
1249-016	34	15	15	Fully	1.00	34	15	15
					Totals, Brechin (2021)	**206**	**95**	**87**
					Totals, Lagoon City & Brechin (2021)	**1,547**	**1,146**	**779**

Note: OPA 17 to the Township of Ramara's Official Plan adjusts the settlement area boundaries for Lagoon City. These adjustments have the effect of adding nine parcels along Ramara Road 47 to the settlement area, which parcels contain four dwellings in DB No. 1246-010 that were not already located in either Lagoon City or Brechin (leaving two dwellings, both on Highway 12 just north of Brechin, outside of the settlement areas). The adjustments also removed approx. 45 parcels in DB No.1248-003 from the Lagoon City settlement area: this removal does not affect the overall dwelling count (as none of the parcels removed is occupied, according to aerial photos). The four dwellings in question appear in aerial photos from 2002, 2008, and 2016.

Appendix "B"
Labour by industry (2016 Census Profile, Ramara Township)

Industry classification (NAICS 2012)[(a)]		Land use / employment type classification	Total number of people employed
22	Utilities	Institutional PRE	65
23	Construction	Industrial PRE	455
31-33	Manufacturing	Employment-Land Employment	380
41	Wholesale trade	Industrial PRE	135
44-45	Retail trade	Commercial PRE	665
48-49	Transportation and warehousing	Employment-Land Employment	185
51	Information and cultural industries	Commercial PRE	60
52	Finance and insurance	Commercial PRE	60
53	Real estate and rental and leasing	Commercial PRE	100
54	Professional, scientific, and technical services	Commercial PRE	190
55	Management of companies and enterprises	N/A	0
56	Administrative and support, waste management and remediation services	Employment-Land Employment	250
61	Educational services	Institutional PRE	255
62	Health care and social assistance	Institutional PRE	525
71	Arts, entertainment, and recreation	Institutional PRE	240
72	Accommodation and food services	Commercial PRE	320
81	Other services (except public administration)	Commercial PRE	195
91	Public administration	Institutional PRE	365

[(a)]Not including "Agriculture, forestry, fishing and hunting" or "Mining, quarrying, and oil and gas extraction".

Commercial PRE	1,590
Institutional PRE	1,450
Industrial PRE	590
Total PRE	3,630
Total ELE	815

Appendix "C" – Population Growth Allocations

This appendix provides the full derivation of the equations shown on p. 22 of this memo, which express the population growth in Lagoon City and Brechin in terms of the overall population growth in Ramara Township.

We start with values either given by, or assumed based on, the growth forecasts prepared in support of Simcoe County's MCR:

- Let $\boldsymbol{\Delta P}$ be the change in the total population of Ramara Township over a given period of time.
- Let $\boldsymbol{h_T}$ be the average household size (in persons per unit) across the Township for a given five-year period.
- Let h_B and h_L be the average household sizes for Brechin and Lagoon City, respectively, where we assume for any five-year period that $h_B = h_T$ and $h_L = k \cdot h_T$, where $\boldsymbol{k}$ is a constant of proportionality. (For present purposes, we assume that $k = 0.8$.)
- Let $\boldsymbol{a}$ represent the percentage of total population growth in the Township that is allocated to the two settlement areas. (We assume throughout this memo that $a = 0.24$.)
- Let $\Delta(L+B)$ be the change in the populations of Lagoon City and Brechin, respectively, over a given period.

According to the commutative property, $\Delta(L+B) = \Delta L + \Delta B$. Therefore:

$$\Delta L + \Delta B = a \cdot \Delta P \qquad [1]$$

Population change in the settlement areas can be expressed as a function of the change in the total number of dwelling units, Δu_L and Δu_B, based on the average household size, as above; if we assume that the occupancy rate in each settlement area, R_L and R_B, remains constant over time, then the change in the number of dwelling units occupied by usual residents ("occupied dwelling units"), Δd_L and Δd_B, is given by:

$$\Delta d_L = R_L \cdot \Delta u_L \qquad [2a]$$

$$\Delta d_B = R_B \cdot \Delta u_B \qquad [2b]$$

Population change can therefore be expressed as follows:

$$\Delta L = h_L \cdot \Delta d_L \qquad [3a]$$

$$\Delta B = h_B \cdot \Delta d_B \qquad [3b]$$

Substituting from 2a and 2b and using our assumptions about average household size:

$$\Delta L = k \cdot h_T R_L \cdot \Delta u_L \qquad [4a]$$

$$\Delta B = h_T R_B \cdot \Delta u_B \qquad [4b]$$

We assume that the total number of dwelling units in the two settlement areas increases according to some constant ratio, D, based on the availability of residential land in each settlement area (vacant lots, intensifiable lots, and developable area), as described in the body of this memo. We therefore assume that:

$$\Delta u_B = D \cdot \Delta u_L \qquad [5]$$

Substituting [5] into [4b] gives:

$$\Delta B = h_T R_B D \cdot \Delta u_L \qquad [6]$$

Solving [4a] and [6] for Δu_L:

$$\Delta u_L = \frac{\Delta L}{k \cdot h_T R_L} \qquad [\textit{from } 4a]$$

$$\Delta u_B = \frac{\Delta B}{h_T R_B D} \qquad [\textit{from } 6]$$

Therefore:

$$\frac{\Delta L}{k \cdot h_T R_L} = \frac{\Delta B}{h_T R_B D}$$

$$h_T R_B D \cdot \Delta L = k \cdot h_T R_L \cdot \Delta B$$

$$h_T R_B D \cdot \Delta L - k \cdot h_T R_L \cdot \Delta B = 0 \qquad [7]$$

We now have a system of two equations, [1] and [7], and two unknowns, ΔL and ΔB, which we can solve by multiplying [1] by $k \cdot h_T R_L$ and adding it to [7]:

$$k \cdot h_T R_L \cdot \Delta L + k \cdot h_T R_L \cdot \Delta B = k \cdot h_T R_L \cdot a \cdot \Delta P \qquad [1] \times k \cdot h_T R_L$$

$$h_T R_B D \cdot \Delta L - k \cdot h_T R_L \cdot \Delta B = 0 \qquad [7]$$

$$k \cdot h_T R_L \cdot \Delta L \cancel{+ k \cdot h_T R_L \cdot \Delta B} + h_T R_B D \cdot \Delta L \cancel{- k \cdot h_T R_L \cdot \Delta B} = k \cdot h_T R_L \cdot a \cdot \Delta P$$

$$k \cdot \cancel{h_T} R_L \cdot \Delta L + \cancel{h_T} R_B D \cdot \Delta L = k \cdot \cancel{h_T} R_L \cdot a \cdot \Delta P$$

$$(k \cdot R_L + R_B D) \cdot \Delta L = k \cdot R_L \cdot a \cdot \Delta P$$

and therefore:

$$\Delta L = \frac{k \cdot R_L}{k \cdot R_L + R_B D} a \cdot \Delta P \qquad [8]$$

We can now substitute [8] into [1] and solve for ΔB:

$$\Delta B = a \cdot \Delta P - \Delta L \qquad \text{[from 1]}$$

$$\Delta B = a \cdot \Delta P - \frac{k \cdot R_L \cdot a}{k \cdot R_L + R_B D} \cdot \Delta P$$

$$\Delta B = \left(1 - \frac{k \cdot R_L}{k \cdot R_L + R_B D}\right) \cdot a \cdot \Delta P$$

$$\Delta B = \left(\frac{\cancel{k \cdot R_L} + R_B D}{k \cdot R_L + R_B D} - \frac{\cancel{k \cdot R_L}}{k \cdot R_L + R_B D}\right) \cdot a \cdot \Delta P$$

$$\Delta B = \frac{R_B D}{k \cdot R_L + R_B D} a \cdot \Delta P \qquad [9]$$

Thus, for any given ΔP, equations [8] and [9] allow us to determine the allocation of population growth between Lagoon City and Brechin using assumed values for a, k, D, R_L, and R_B. These are the two equations shown on p. 22 of the memo.